SYMPOSIUM ON TAXONOMY[1]

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INTRODUCTION

A number of years ago, Professor Robert S. Breed and the late Colonel A. Parker Hitchens initiated the gathering of bacteriologists at the annual meeting of the Society of American Bacteriologists to discuss problems and advancements in the classification of microorganisms. The discussions have served as a place for airing taxonomic opinions. They have aroused much interest which at times resulted in noteworthy contributions to the classification of microorganisms. The 1955 symposium was organized by Professor Breed. Summaries of the papers presented follow.

[1] This symposium was presented before the Fifty-fifth General Meeting of the Society of American Bacteriologists at New York, New York, on May 12, 1955. Professor R. G. D. Murray presided, and Margaret Pittman served as secretary.

PART 1. SOME COMPARISONS BETWEEN THE GENERAL OUTLINE CLASSIFICATION PROPOSED BY KRASSILNIKOV, 1949, AND THE OUTLINE CLASSIFICATION THAT WILL BE USED IN 7TH EDITION OF BERGEY'S MANUAL

ROBERT S. BREED

Krassilnikov (10) recognized four classes in *Protophyta* Sachs, 1874; *Actinomycetes* Krassilnikov, 1945; *Eubacteriae* Stanier and van Niel, 1941; *Myxobacteriae* Heller, 1921, and *Spirochaetae* Stanier and van Niel, 1941; in these four classes he recognized 23 families and 88 genera. In the comparable groups in the sixth edition of Bergey's Manual (1), 38 families and 131 genera were recognized, and in the seventh edition at least 47 families and 200 genera will be recognized. The families were placed in 5 orders in the sixth edition and will be in 10 in the seventh edition.

Motility is used in Krassilnikov's classification as the primary basis of distinction between Class I—*Actinomycetes*, and Class II—*Eubacteriae*. As a result, organisms such as those in *Propionibacterium*, *Lactobacterium*, *Pseudobacterium*, *Micrococcus*, *Nitrosococcus*, *Diplococcus*, *Neisseria*, *Streptococcus* and *Sarcina* are placed in the class *Actinomycetes*, while all of the polar and peritrichous flagellate bacteria are placed in the class *Eubacteriae*. Two genera, *Pseudobacterium* Krassilnikov, 1945, and *Bacterium* Ehrenberg include respectively miscellaneous species of non-motile and motile bacteria not found in other recognized genera of the non-motile and the motile bacteria. The use of motility as a primary basis for classification does not work out satisfactorily as there are many species of bacteria where some strains are motile while others are non-motile.

Of the ten orders to be recognized in the seventh edition of the Manual, three include bacteria that are polar flagellate when motile; two include bacteria that are peritrichous when motile; and one contains non-motile, usually branching forms, although recently some water-inhabiting species have been found to produce flagellate swarm spores. The four remaining orders contain bacteria that glide, creep or are flexuous in their movements when they are motile, but do not show flagellation.

PART 2. CHANGES IN THE CLASSIFICATION OF ORDER *Rickettsiales* AS PROPOSED FOR 7TH EDITION OF BERGEY'S MANUAL

CORNELIUS B. PHILIP

The major changes that are proposed for the order *Rickettsiales* are as follows. Family I, *Rickettsiaceae* Pinkerton, 1936, will contain three tribes: I *Rickettsieae* Philip, 1953 (the human rickettsioses), II *Ehrlichieae* Philip, 1953 (the animal rickettsioses), and III *Wolbachieae nov.* (arthropod inhabitants not known to be pathogenic for vertebrates). The latter will contain two new genera with one species each: one for the symbiotic *Rickettsia lectularia* of the bedbug, and another for the filterable *Coxiella popillae* of the beetle larvae. Family II designated as *Chlamydozoaceae* in the sixth edition is illegitimate as it is based on the invalid genotype species *Chlamydozoon trachomatis* Foley and Parrot, 1937. *Chlamydozoon bombycis* Prowazek, 1907, originally associated with a silkworm disease, has priority. A new family name will be needed and three new genera will be proposed. Family III *Bartonellaceae* Gieszcykiewicz, 1939, will have only minor changes, but the genus *Anaplasma* Theiler, 1910, will be included possibly in a separate family. A supplement will contain the intracellular parasites of *Protozoa*.

PART 3. NEW DEVELOPMENTS IN THE CLASSIFICATION OF THE ORGANISMS PLACED IN THE ORDER *Actinomycetales*

a. The genus *Mycococcus* Krassilnikov, 1938

LOIS NELLIS

In a series of papers, Krassilnikov (7, 8, 9) described some bacteria isolated from soil which he placed in a new genus *Mycococcus* in the order *Actinomycetales* (Krassilnikov, 1949.) Six species are listed, 5 of which are chromogenic. The bacteria are usually spherical but on certain media, irregular coccoid and rod forms appear. They occur singly and in pairs and clumps; in some species tetrads and capsules are formed. Vegetative cells tend to change to resting cells which germinate by forming germ tubes. This process is considered to be similar to conidiospore germination in the actinomycetes. Reproduction also occurs by fission, constriction, and bud formation.

The description of these bacteria has been organized for inclusion in the seventh edition of Bergey's Manual in genus *Mycococcus* in family *Mycobacteriaceae*. The bacteria appear to resemble *Mycobacterium* more than *Nocardia* because of their colonial appearance, their lack of mycelium, their oxygen requirements, and their reaction to gram staining. They are not acid-fast. Their coccus forms and biochemical reactions suggest a relation to *Micrococcus*.

The discussion following the paper centered around the advisability of placing this group of bacteria as a second genus in *Mycobacteriaceae*, which would require the separation of the genera on the basis of acid fastness. Lack of information on whether action on carbohydrates is by oxidation or reduction was also discussed. It was proposed that these bacteria not be placed in a known group but that they be placed provisionally in an appendix and that cultures be obtained and studied before a decision is reached on their place in the classification of the Manual.

b. The family *Actinoplanaceae*

JOHN N. COUCH

The description of the organisms classified in the two genera *Actinoplanes* and *Streptosporangium* of family *Actinoplanaceae* (5)[2] was reviewed. *Actinoplanes* was accidentally discovered in a search for aquatic fungi. More than 150 isolations have been obtained from soils from many places with the use of pollen, boiled grass leaves, and other substrata. Pollen of *Liquidamber* has been the best bait. *Actinoplanaceae* is characterized primarily by the formation of spores in sporangia; and the size, shape and method of development and dehiscence of the sporangia furnish means of differentiating the species. *Actinoplanes* has a mycelium similar to that of *Micromonospora* but differs in the formation of sporangia and in having flagellated swimming spores. The spores are usually subglobose or slightly elongated with a tuft of many flagella attached close to the anterior end. *Streptosporangium* has a better developed aerial mycelium with spherical sporangia that form non-flagellated, non-motile spores. The nuclear material of the organisms stains similarly to that of true bacteria. This family may represent the connection between the bacteria and the lower aquatic *Phycomycetes*.

PART 4. THE FAMILY *Corynebacteriaceae*

a. The status of the genus *Krusella* Castellani, 1954

E. M. D. CLEVELAND

Castellani (2, 3) described an organism isolated from a case of varicosoid ulcer. It was diphtheroid in appearance but actively motile. Since its characteristics differed from those of other known members of *Corynebacteriaceae*, he proposed a new genus for it, *Krusella*, type species *K. cascainensis*.

Strains of the organism designated 1 and 2 were received from Dr. Castellani and also from the American Type Culture Collection. They appeared to be physiologically identical. The morphological and physiological characteristics were found to be in agreement with those given in the original description with an important exception. When cultures of strain 1 were grown on nutrient agar for five days at 21 C, they produced oval, central to subterminal spores, without swelling of the rod. The spores could be demonstrated readily in gram or spore stained preparations. The organism is definitely not a corynebacterium. It belongs in the genus *Bacillus* and consequently there can be no genus *Krusella*. Further studies are to be made in order to identify the species to which this organism belongs.

[2] In the cited reference the name of the family containing the genera *Actinoplanes* and *Streptosporangium* was given as *Actinosporangiaceae*. Later the name was changed to *Actinoplanaceae* to conform to the international rules for nomenclature (Couch, J. N., J. Elisha Mitchell Sci. Soc. November 1955, in press).

b. Anaerobic corynebacteria

HEINZ SEELIGER

The present classification of the anaerobic corynebacteria is unsatisfactory. A redescription of *Corynebacterium acnes* Gilchrist based on the work performed since 1930 by Holm, Prévot and Courdurier, Douglas and Guenther, Lentze, Seeliger, Beerens, and Linzenmeier has been prepared. *C. liquefaciens* Jungano is considered as an illegitimate homonym of *C. acnes*. *C. parvum*, *C. granulosum* and *C. diphtheroides*, as described by Prévot and his coworkers, are different from *C. acnes* and are regarded as distinct species.

c. The bovine corynebacteria

E. V. MORSE

The economically important animal pathogens of the genus *Corynebacterium* are *C. pyogenes*, *C. pseudotuberculosis*, *C. renale*, and *C. equi*. Each has distinguishing characteristics and when isolated from its natural host is pathogenic for certain laboratory animals. Although *C. bovis* has been cultured from bovine milk, no reports indicate a role in pathological processes of the bovine udder. *C. striatum* (synonym *C. flavidum*), isolated from both human nasal secretion and milk of cows which have mastitis, is pathogenic for guinea pigs and mice. Its habitat indicates that it has human and bovine health significance. Attention was directed to the ubiquity of the distribution of diphtheroid organisms, many of which await study for classification (13).

d. Designation of *Corynebacterium ureafaciens* Krebs and Eggleston as *Arthrobacter ureafaciens comb. nov.*

FRANCIS E. CLARK

Dubos and Miller (6) isolated a urease negative organism which could use creatine as the sole source of carbon and nitrogen. They designated the culture NC. Krebs and Eggleston (11) studied the culture and named it *Corynebacterium ureafaciens*. In 1941, Dubos sent strain NC to the American Type Culture Collection labeled *Corynebacterium creatinovorans*. It was so listed and this name has since appeared in several publications.

The ATCC strain has been compared with a large number of strains of corynebacteria of soil, plant and animal origin. Only four were culturally similar to it; *i.e.*, three strains labeled *Arthrobacter aurescens*, which were received from H. J. Conn and an unnamed one, T178, from Topping (15). It is recommended that the genus *Arthrobacter* Conn and Dimmick (4) be recognized to accommodate the corynebacteria of soil origin that grow readily on inorganic media and with the recognition of the species *Arthrobacter ureafaciens comb. nov.*, that the names *Corynebacterium creatinovorans*, not validly published, and *Arthrobacter aurescens* Phillips (14) be reduced to synonymy.

e. Taxonomic position of the motile phytopathogenic coryneforms

M. P. STARR

Most, if not all, of the gram-positive phytopathogenic bacteria resemble the diphtheroids morphologically. Their physiology, serology and metabolism have been given scant attention; however, present knowledge of them is compatible with placement in *Corynebacterium* as it is now defined. In view of the paucity of information available on the biology and chemistry of these phytopathogenic coryneforms, the inclusion of two motile species is not particularly disturbing. No change in taxonomic philosophy would need to be invoked; motile species have been described and accepted in several "nonmotile" genera: *Streptococcus*, *Lactobacillus*, and *Nocardia*. If future work shows that these motile species are otherwise typical corynebacteria, motility *per se* should not require their exile from *Corynebacterium*.

PART 5. THE GENUS *Bordetella* MORENO-LÓPEZ, 1952

MARGARET PITTMAN

Evidence that has been accumulating for more than 30 years amply justifies the grouping of the species *Bordetella pertussis*, *Bordetella parapertussis*, and *Bordetella bronchiseptica* in a new genus, *Bordetella* (12). The bacteria in each species have in common like morphology, growth requirement for nicotinic acid, inability to utilize carbohydrates, production of alkalinity in litmus milk and a common toxin, the same O antigen, and pathogenicity for the upper respiratory tract. They differ from the bacteria in *Haemophilus* in growth requirements, biochemical activity, and lack of serological relationship. *B. bronchiseptica* formerly classified in the genera *Brucella* and *Alcaligenes* differs from the brucellae in motility and lack of requirement of thiamin for growth, from *A. faecalis* in production of hemolysis, inability to grow in organic carbon-salts medium and rapid production of urea, and from both in lack of a proven serological relationship. The creation of a new genus is a logical solution to an anomalous situation.

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